External Ophthalmomyiasis, A Disease Established in Hawaii

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External ophthalmomyiasis, usually caused by the sheep nasal bot fly, Oestrus ovis L., *is characteristically a benign disorder in humans, but may rarely cause severe complications. It occurs on most of the inhabited Hawaiian islands, and is more common than indicated by previously published reports. A typical case is presented along with the fly's life cycle, clinical features, and management.*

Introduction

Myiasis in its broadest sense refers to the infestation of tissue by the larvae of flies (order Diptera). The consequences of such invasions may range from asymptomatic infestations to severe reactions and even death.[1] Various sites on a human host may be involved, depending upon the behavior of the particular species of fly, the types of clothing worn, other cultural practices which influence human contact with flies, and chance. Ophthalmomyiasis is the term for myiasis of the eye or its adnexae, and is subdivided into internal and external types, according to whether the globe itself is invaded.[2]

Internal ophthalmomyiasis is a relatively rare disorder and often leads to serious complications due to destruction of intraocular tissues. External ophthalmomyiasis is reported more frequently, but nonetheless is so striking a condition that its occurrence continues to elicit individual case reports in the medical literature. Although a case of external ophthalmomyiasis was reported in Hawaii as long ago as 1925,[3] only a few other Hawaiian cases have been published. As a consequence, many health care providers may be unaware of this disease, its manifestations, management, or potential complications.

Illustrative Case

A 63-year-old man was working on a car near his house in a residential section of Waianae (island of Oahu) when he felt a light "thud" in his left eye and thereafter experienced a burning sensation and tearing of the affected eye. His son examined the eye and saw something moving, but could not catch it.

The man sought medical attention. At the emergency department, he reported considerable irritation of the eye, slight visual blurring, and the sensation of a moving foreign body. Examination revealed swelling of the eyelids, marked lacrimation, mild injection of the bulbar conjunctiva, and numerous larvae about 1 mm long, rapidly traversing the bulbar and palpebral conjunctivae. Although instillation of proparacaine hydrochloride 0.5% ophthalmic solution did not appreciably slow larval movements, it improved the patient's comfort as the larvae were removed with the aid of a lightly moistened cotton-tipped applicator. About 11 larvae were recovered in this fashion.

On the following day, the patient was re-examined by an ophthalmologist, who discovered and removed one additional larva. Two days later, the patient reported no further irritation in the eye. The larvae were submitted to one of the authors (M.L.G.) and found to be the first instar (or stage) of *Oestrus ovis* L. (see Figures 1 and 2).

Fig. 1.—First instar larva of Oestrus ovis showing anterior segments and cephalopharyngeal skeleton. Magnification 125X.

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Fig. 2.—First instar larva of Oestrus ovis showing posterior segments and posterior spiracles. Magnification 125X.

Entomologic Aspects

Oestrus ovis L., the sheep nasal bot fly, is the most common cause of human external ophthalmomyiasis worldwide. This insect is a well-known parasite of sheep, goats, and occasionally other animals. While in flight, it is able to deposit its living larvae near their nostrils, an event which evokes considerable annoyance and sometimes causes the animals to fall to their deaths while attempting to flee (*oistros* = gadfly, sting, hence frenzy). The first instar larvae migrate into the nasal cavities and sinuses, feed upon mucous secretions, and ultimately develop into third instar larvae over a period of eight to ten months.[1] When mature, they drop or are sneezed out onto the ground where they pupate. Under Hawaiian conditions, they hatch into adult flies three to six weeks later. The adult does not feed during its lifespan of about four weeks. If humans are attacked, the sites of larval deposition are usually the eyes, and less frequently the ears, nose, or throat.[4,5] Humans are accidental hosts, in whom the larvae generally do not develop beyond the first instar.

O. ovis is now found in all sheep-rearing parts of the world.[6] It was probably introduced to Hawaii along with sheep in the latter part of the eighteenth century, was first recorded by Grimshaw from specimens collected from sheep on Kauai in 1896,[7] and is currently found wherever these animals are present.[8] Despite scanty records, it is also known from domestic or feral goats, *Capra hircus*,[9,10] which are present on most of the inhabited Hawaiian islands.[11] *O. ovis* larvae have recently been identified in feral goats from the Waianae Mountains of Oahu (unpublished observations).

Less common causes of conjunctival myiasis include the horse nasal bot fly, *Rhinoestrus purpureus* Brauer,[12,13,14] and the moose (elk) throat bot fly, *Cephenemyia ulrichii* Brauer,[15] neither of which is present in the Hawaiian Islands. The horse bot fly genus *Gasterophilus* may cause a subconjunctival infestation,[16] and both *Gasterophilus intestinalis* De Geer and *G. nasalis* L. have been reported in Hawaii.[8] However there are no reports of their causing human infestation here.

Hawaii also harbors fly species which can penetrate tissue readily, potentially causing internal ophthalmomyiasis. These include *Hypoderma bovis* L. and *H. lineatum* Villers.[8] Again, we are not aware of reports of ophthalmomyiasis caused by these species in this state.

Geographic Distribution

External ophthalmomyiasis due to the larvae of O. ovis has been reported from many parts of the world. It is particularly common in the Near East[5,14,17] and the Mediterranean basin.[4,18,19,20] Among the Berbers of North Africa, the condition is sufficiently prominent that it has a specific name, *"thimni"*.[21] It is also found in Russia,[22] south Asia,[23] east Asia,[24] southern Africa,[13,25] and South America.[26] External ophthalmomyiasis is occasionally reported from northern Europe,[27] Australia,[28] New Zealand,[29] and Canada.[30] It may be imported into a presumably non-endemic area by infested travelers.[31]

Within the United States, this disorder has been reported most frequently from Santa Catalina Island off the coast of southern California.[32,33,34,35,36] It is also known among sheepherders on the Navaho Reservation (O.H. McKinley, personal communication). Individual cases have been reported from at least twelve other states.

Human infestation with *O. ovis* has previously been described in Hawaii at least four times. One case was reported from Honolulu on the island of Oahu in 1925,[3] three confirmed and three unconfirmed cases from Puako on the island of Hawaii in 1956[37,38] two cases from North Kona on the island of Hawaii in 1983,[10] and one case was acquired on the island of Maui and identified in Canada in 1985.[31] An investigation into the occurrence of external ophthalmomyiasis in Hawaii is in progress and has located more than 20 additional cases from the islands of Niihau (D. Jamieson, personal communication), Kauai, Oahu, Maui, Lanai, and Hawaii, with positive identification of *O. ovis* larvae in several of the cases (unpublished observations).

Clinical Features

A human victim may or may not feel the strike of the adult female fly as she deposits larvae. The usual symptoms of infestation include a moving foreign body sensation, itching, burning, and lacrimation.[19,20,35] Marginal corneal ulcerations may occur, producing pain and photophobia.[20] The patient or a companion may remove some or all of the larvae. The illness is generally self-limited,[20,35] lasting no more than about 10 days without treatment. These larvae have not been known to develop beyond the first instar in human conjunctivae.

Upon presentation to medical care, examination may reveal lacrimation, conjunctival injection, swelling of the lids, and possibly a punctate keratitis or corneal ulceration.[17,20] Careful examination with a slit lamp or other magnification will reveal the motile first instar larvae, about 1 mm in length, translucent white in color with anterior black hooks connected to the remainder of the cephalopharyngeal skeleton, and rows of spines between the 11 body segments (see Figure 1). The examiner should take care to evert or doubly evert the lids to facilitate the search,[20] since the larvae actively avoid the light by crawling into the sulci.

It is possible to demonstrate serum antibody to the three larval instars of *O. ovis* in sheep and goats,[39] but these tests are not commercially available for testing humans, nor are they necessary for clinical management.

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Management

The larvae should be mechanically removed, either by irrigation with a suitable solution or with jeweler's forceps, a lightly moistened small cotton bud, or other similar aid. Since the larvae are actively motile, avoid the light, and may cling to tissue by means of their hooks, removal may be facilitated by immobilizing them with cocaine, lidocaine, or pilocarpine drops. Cocaine (4% to 5% solution) is a very effective means of paralyzing the larvae,[40] but is often unavailable in medical offices in the United States. Lidocaine, usually available in the form of a solution for injection, has also been advocated.[40] Pilocarpine 1% ophthalmic solution, commonly available as a treatment for glaucoma, slows larval movement *in vitro* within about 5 minutes, although it may be less effective *in vivo* due to dilution with tears (P. Bjorkman, personal communication). Pilocarpine 4% ophthalmic solution may be more effective, but our experience with it is limited.

As many as 77 larvae have been recovered from a human eye at one time,[41] although a smaller number is more common. Removal may require more than one session due to fatigue of the patient and the operator. If the conjunctiva or cornea is significantly disrupted, consideration should be given to tetanus immunization and antimicrobial prophylaxis.

Submission of the recovered larvae to an experienced entomologist for positive identification is recommended. The reason is that the treating clinician should be alerted in the event that the infestation involves a fly such as *Hypoderma* sp., whose larvae may easily penetrate the eye, with potentially devastating consequences. The larvae may be preserved in 35% isopropyl alcohol (half-strength rubbing alcohol) or 70% ethyl alcohol.

Re-examination of the patient on the following day is strongly advised, because initial treatment often fails to detect all of the nearly transparent larvae hiding deep in the sulci.[20,42]

Symptoms and signs generally resolve within several days after complete removal of the larvae. Persisting symptoms should prompt further evaluation for remaining larvae or for complications.

Complications

Although external ophthalmomyiasis caused by *O. ovis* is virtually always self-limited,[20,35] serious complications are possible. Clinicians have observed marginal corneal ulcerations;[20] corneal abrasions, sometimes linear, suggesting injury by the adult fly in the course of striking the eye;[25] small conjunctival hemorrhages;[14] and punctate keratitis.[14] These superficial injuries may be managed by conventional means, with a topical antibiotic and close follow-up. Schenck reported one case probably caused by *O. ovis* in which larvae had penetrated the bulbar conjunctiva.[43] The most severe complication occurred in a case seen by Rakusin in South Africa. Larval O. ovis penetrated the globe, with resulting optic neuritis, panuveitis, optic atrophy, and visual loss.[44] Finally, larvae of certain other species of flies regularly penetrate tissues, and after initial deposition around the conjunctiva or ocular adnexae, may proceed to damage the globe.[16,45] Should internal ophthalmomyiasis be detected, treatment options include no treatment for a dead larva with no inflammatory reaction,[45] vitrectomy for an accessible larva producing inflammation,[46] and laser photocoagulation.[47]

In *O. ovis* ophthalmomyiasis, patients sometimes report sneezing or other nasal symptoms. These have generally been self-limited, suggesting the possibility of a local reaction to larval or adult fly products which have been carried by tears into the nasal cavity. There has been a case of an *O. ovis* larva physically entering the nasolacrimal duct,[48] from which it would have access to the nasal and sinus cavities. In these sites, the larvae may persist longer than in the conjunctivae.[4,49] Recently, there has been a report of *O. ovis* development to the third instar over about six weeks in the nasal and sinus cavities of a patient infected with the human immunodeficiency (HIV) virus.[50] There is also a recorded case of a larva negotiating the Eustachian tube to reach the middle ear.[4] These migratory complications of external ophthalmomyiasis may simulate direct larval deposition into the nasal cavity (or mouth or ear) by the initial fly strike.[4,5]

Conclusions

External ophthalmomyiasis, usually caused by the first instar larvae of the sheep nasal bot fly *Oestrus ovis* L., is generally a benign (but annoying) disorder in humans, producing a self-limited parasitic conjunctivitis. It is well known in certain geographic areas, particularly the Near East and Mediterranean basin, but is uncommon in the United States. Increased scrutiny in the Hawaiian Islands has revealed that it occurs much more frequently than previously reported. Greater awareness of this disease may facilitate its diagnosis, management, and the prevention of complications. Studies are in progress to determine its distribution in Hawaii, the animal reservoirs of *O. ovis*, and the potential for controlling or preventing infestation in animals and humans.

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